## TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE

The two-stroke cycle engine shown in Fig. 1 was originally designed and developed as a mass production problem. Twenty engines plus the jigs and fixtures needed to do the manufacturing were constructed at that time.

This particular engine is offered as a basic design. It is possible through modifications to increase power and reduce weight until the engine can be used to power a model airplane with a 5 ft, wing span. Weight reduction can be accomplished by thinning cylinder walls and rounding off square corners.

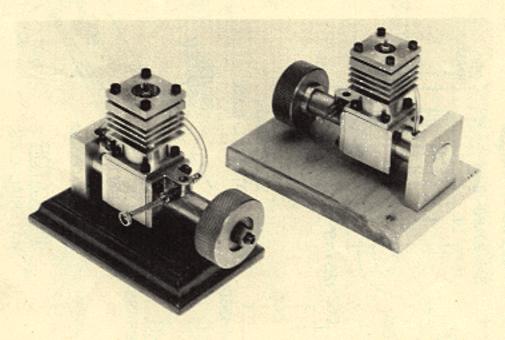


Fig. 1. Two-stroke cycle engine.

## CONSTRUCTION

First make the crankcase, then the cylinder.

The crankcase front can be cast or machined and fabricated from solid stock. If cast, a pattern must be made. If you

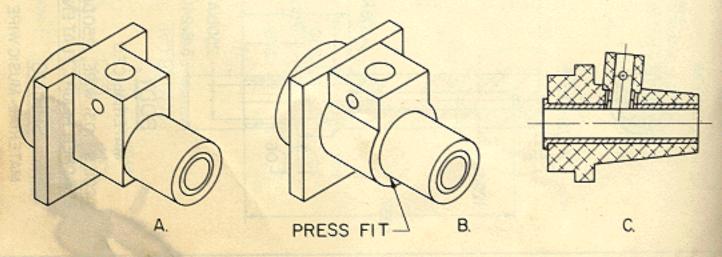
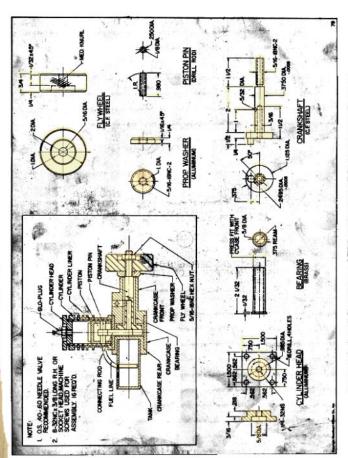


Fig. 2. Three methods of machining the two cycle engine crankcase.



"Break-in" the engine by running the lattle for 10 to 15 minutes, increasing lathe speed during the last lew minutes. Then, clean the entire engine in a solvent and apply new engine oil. Fill the fuel tank with a good grade of glow engine ruel that contains a large percentage of castor oil. Fit and tighten the glow plug into the head.

## **OPERATION**

Mount the angine in a vise, using wood blocks to protect the metal surfaces. Open the needle valve about three fu<sup>[]</sup> turns. Have someone place a finger over the intake while you rapidly rotate the flywheel in a counterclockwise direction.

- 1. If fuel is drawn through the fuel line, you are needy to attach the bettery terminal to the plug and start the angine.
- 2. If no fuel is drawn into the line, check the following possible causes and make needed corrections.
  - Exhibits port does not "open" before intake port. Correct as shown in Fig. 5.

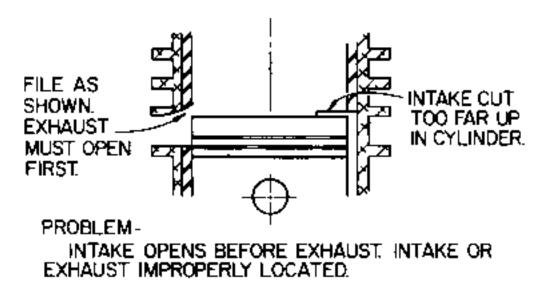


Fig. 5. Solution to improperly placed ports.

- Intake part does not open. Correct as shown in Fig. 6.
- e. Intake hole in crankshaft is incorrectly "timed." Hole should start to open as piston starts up in cylinder, it should remain open until piston reaches TDC (top dead center). A minor correction can be made by filing. Otherwisk a new crankshaft will have to be made.
- d. Intake hole in crankshalt does not align with intake hole in crankcase. Correct by redrilling.

With fuel in the fuel line, prime the cylinder (through the exhaust port) with a few drops of fuel. Snap the engine over smartly in a counterclockwise direction. The flywheel should rebound slightly.

Attach the battery terminal to the glow plug and ground the other terminal to the engine. The plug should glow a bright orange (almost a vellow).

Reprime through the exhaust port and shap the flywheel in a counterclockwise direction. A heavy cord wrapped around

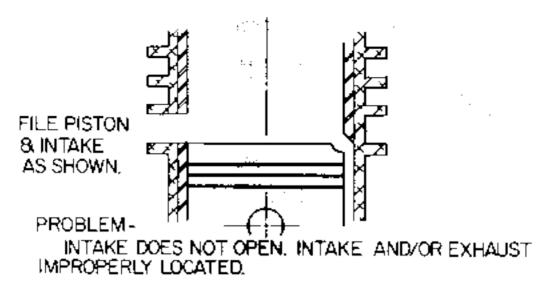


Fig. 6. Second solution to improperty placed two cycle engine ports.

the flywheal will aid in starting. If available, an electric starter specifically designed to start model amplane engines is best of all. It never fails to start an engine that is properly set up,

- 1. If the engine will not fire, check for the following possible causes:
  - a. Battery short circuit.

- d. Little or no compression.
- b. Glow plug partially or fully burned out.
- e. Old luct.

- c. Bettery run down.
- 2. If the engine "fires" but does not start, it may be flooded.
  - a. Close needle valve completely and turn engine over rapidly. Engine should start and run out of excess fuel.
  - b. If engine does not start, examine spray bar of needle valve assembly. Most have one hole which should be centered in the intake (use small washers as spacers) and face down. If spray bar has two holes, position bar so that holes are centered, and parallel to crankshaft,
  - c. Open needle valve 2 to 2 1/2 turns and try to start engine. Adjust needle valve until engine runs.
- 3. If engine runs, then "dies" after prime is consumed, open needle valve another 1/4 turn and try again.
- Check to see it engine is drawing fuel by noting movement of small bubbles in fuel line. If no fuel is being drawn, check
  for the following problems and make necessary corrections.
  - Dirt in risedle valve.

- e. Glow plug toose in head.
- b. Fuel hole pressed against bottom of fuel tank.
- 1. No compression.

c. Dirt in fuel line.

- g. Old fuel.
- d. Joints leak and engine may require paskets.

Fig. 3. Drawings for two cycle engine parts: crankages, piston, cylinder, cylinder liner and fuel tank

decide to machine the part from solid stock, you have your choice of the three possibilities shown in Fig. 2. No dimensions are given, so YOU can solve the problem.

The cylinder liner may be made from seamless steel tubing, Fig. 3, or machined from bar stock. Ream or machine the bore to size, being careful to use an ample supply of cutting fluid to assure a smooth finish.

You can obtain a lapped finish on the bore by making an aluminum or brass lapping bar 0.0005 in, smaller than the bore.

Machine several shallow grooves about 1/2 in, apart on the lapping bar. Use a very fine lapping compound or tooth powder
and plenty of cutting oil. Move the charged lapping bar back and forth in the bore.

Protect the machine from surplus lapping compound. From time to time, remove the compound with gasoline or thinner and measure the bore. This is done to be sure the bore is uniform in diameter along its length. A very slight "belling" is permitted at the bottom of the cylinder liner.

Make the piston next. It should be a snug fit in the cylinder bore. Use an ample supply of lube oil on the bore and piston when making the fit. The piston will "run in" after several minutes of operation. A good seal between cylinder bore and piston will occur because the piston (aluminum) will expand slightly more than the cylinder liner (steel) as the engine heats up during operation.

There is no set sequence that must be followed to manufacture the remaining parts, Figs. 3 and 4. However, use care in tapping the small holes. It is almost impossible to remove broken taps from the aluminum engine parts without the use of an electronic tap disintegrator. Securing the 1/4-32NS tap needed to cut threads in the head may be a problem. Most production machine shops have a tap of this size. A local shopowner may loan it to you.

Carefully remove all burss and chips from the machined parts. Clean them in a good solvent. Place a coating of engine oil on the parts as they are assembled. Generally, no gaskets are needed. (If leaks develop around any of the joints, make gaskets from old playing cards.)

The glow plug, plastic fuel line and needle valve assembly can be purchased from any good hobby shop handling model airplane or boat supplies.

When completely assembled, except for the glow plug, the engine should turn over freely. If not, check for binding parts and correct the problem.

## BREAK-IN

Place the engine in a lathe with the chuck gripping the flywheel. Remove the glow plug and place several drops of engine oil in the cylinder. With the plug removed and the lathe adjusted to operate at a slow speed, run the lathe in REVERSE. Grip the engine lightly so that it will easily slip from your hand should the engine "freeze" (seize).